Vapor Phase Soldering System

Instruction Manual

MP MASTER
MA32835

DYNAPERT HTC
EMHART

Pond Lane, Concord MA 01742 617-369-1110
TWX 710 347-6548 TELEX 948287 HTC CNCM

INSTRUCTIONS FOR THE CHANGING OF THE FILTER ON THE FC-70 FILTERING PUMP SYSTEM OF THE VAPOR SOLDER EQUIPMENT

LE 11-1453

CAUTION:

- o USE OF RESPIRATOR IS REQUIRED
- o USE OF RUBBER GLOVES AND SLEEVES IS REQUIRED

1- Remove AC cord from equipment.
2- Open exhaust vents to maximum.
Remove lower front cover.
3- Remove silicone rubber cement from the top of the filter housing. This is covering the nut used to lock filter cover in place.
4- Remove small vent nut on top of housing. Drain nut at bottom of housing is not removable.
5- Place container under housing to catch fluid escaping upon opening the housing.
6- Turn large nut at the top of the housing. This will allow the filter cover to be removed. Pour excess fluid into the chlorinated solvent drain. Wipe parts clean including housing seal. Place wipes and dirty filter into plastic bag and mark - CONTAMINATED - FC 70. These should be disposed of as contaminated waste.
7- Place new filter into cover. (Filters are stored in maintenance area.). Making sure gasket is in place, replace cover into housing, compressing filter in the process. Tighten large nut at the top of the housing. Replace and tighten small nut.
8- Using RTV sealant seal around large nut.
9- Allow sealant to harden. Make sure nuts are tight.
10- Replace AC cord in AC outlet.
11- Turn on filter switch, check for leaks around seals in the recirculating system.
12- Clean up any mess.
13- Replace lower front cover and return exhaust vents to original settings

READY TO USE

Paul Hague and
Ken Mc Craw have
experience for this.

6/12/92

TE 11-1453

6/12/93

PHASE-FOUR

DUAL VAPOR PHASE SOLDER SYSTEM

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

MODEL 912

DYNAPERT-HTC
Pond Lane
508 Beverly Concord, MA 01742
~~(617) 369-1110~~ 927-4200
TWX 710 347-6548
TELEX 948287 HTC CNCM

SERIAL NO. 101159 3347

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HTC MODEL 912

DUAL VAPOR SOLDERING SYSTEM

FOREWORD

HTC has dedicated its resources to the development and improvement of vapor phase heating technology since 1974. This effort has now evolved into the commercial implementation of a new soldering method for specific requirements from prototyping to large-scale production. The company is located in a restored 19th century mill in historic Concord, Massachusetts, on a site that has produced lumber, textiles, and iron from as early as 1630. In this environment, HTC continues the tradition of intellectual integrity, aggressive development, and ingenious productivity so long associated with New England craftsmen. Its sales force and After Order Support representatives are always ready to work with new ideas to make production of high technology products more reliable and profitable.

This Installation, Operation, and Maintenance Manual for the Dual Vapor batch system has been prepared in a manner consistent with the high quality of material, workmanship, and finish provided in all PHASE-FOUR Vapor Phase Soldering Systems. It contains detailed and complete guidance in the installation, initial setup, operation, maintenance, and troubleshooting of the Dual Vapor system. By reading this manual carefully from the beginning and adhering to the sequence of directions for each procedure, the user will be able to install and operate the Dual Vapor system without difficulty.

The PHASE-FOUR heating system requires prior familiarity with its intended uses to achieve a high level of operator proficiency. Therefore, a thorough review of this manual is essential to assure trouble-free operation of the system. If, after reading this manual, difficulties are encountered, feel free to call the HTC After Order Support representative in Concord, Massachusetts . . .(617) 369-1110.

1.0 INTRODUCTION

1.1 THE VAPOR PHASE PROCESS

The vapor phase process utilizes the latent heat of vaporization of a fluid condensing from its saturated vapor phase. This phase change results in extremely rapid and efficient transfer of heat energy from the vapor to a cooler product immersed into the vapor.

When product is lowered into the region of saturated vapor above the boiling heat transfer fluid, the vapor immediately condenses on all the surfaces of the cooler part, heating it rapidly and uniformly to a temperature approaching that of the vapor. Since the temperature of a saturated vapor is equal to the boiling point of the fluid, the working temperature is determined not by the energy input, but by a physical characteristic (the boiling point) of the particular fluid. For any given fluid, this temperature is constant at a given atmospheric pressure, resulting in a process that is precisely controlled and repeatable, without intricate and costly temperature control equipment. The amount of energy applied may be varied without affecting the temperature of the vapor. The process is simple, flexible, and adaptable to a variety of applications, regardless of product geometry.

The temperature of the heated piece asymptotically approaches the temperature of the vapor. Heating is constant and uniform on all surfaces. As the temperature differential in an area decreases, the rate of condensation on that surface decreases, and progressively less heat is transferred to that area. (See Figure 1-1.) An area of larger cross section (with greater mass) will take a longer time to heat up, and will continue to produce condensate and absorb the latent heat of vaporization until the entire piece approaches the temperature of the vapor. Temperatures in the piece will never exceed that of the vapor and thermal shock and distortion are minimal because of the relatively even heating. Given that the product can tolerate the saturated vapor temperature, it is impossible to overheat one area while other areas are still coming up to temperature.

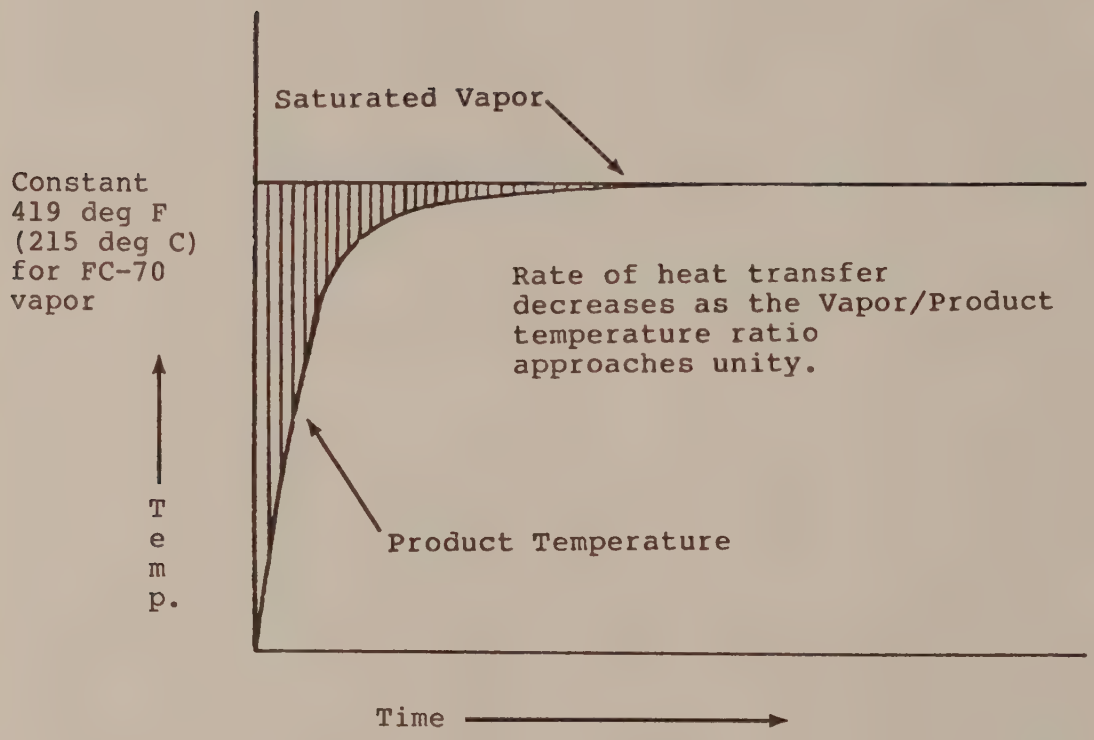

Figure 1-1 Asymptotic Heating

1.2 SYSTEM DESCRIPTIONS

1.2.1 GENERAL DESCRIPTION

Figure 1-2 shows the Model 912 system with its front panel removed. The callouts identify the major subsystems within the unit.

The Model 912 is constructed within a formed steel framework (1) with easily removable panels. It is 21.50 inches deep by 29.00 inches wide by 46.00 inches high (54.6 cm by 73.7 cm by 116.8 cm) (excluding the leveling legs). The combination elevator housing/ventilation hood (2) has the control panel (3) on its front face. The primary fluid filtration system (4) and the cooling water supply lines for the vapor condensing coils (5) are inside the main housing. An external storage bottle (6) contains the secondary fluid supply and is connected to the secondary fluid regulator valve (7). The elevator basket (8) hangs from the elevator crossbar.

In addition to the control panel on the front, the elevator housing (Figure 1-3) contains:

- Elevator drive motor (1),
- Basket support chains (2),
- Power circuit breaker (3),
- Control power fuse (4),
- Elevator speed control fuse (5),
- Transformer fuses (6),
- 230/115 VAC step-down transformer (7),
- Heater power contactor (8),
- Proportional power controller (9),
- Grounding bar (10),
- Elevator motor speed controller (11),
- IDLE power control (12),
- Step programmer (13),
- Elevator false start relay (14),
- Heating element overtemperature controller (15),
- Step programmer limit switch (16), and
- Idle/reflow limit switch (17).

The power subsystem does not require attention except for adjustment of the heating element overtemperature controller (15) at initial startup.

1. Main Frame
2. Elevator Housing/Ventilation Hood
3. Control Panel
4. Primary Fluid Filtration System
5. Cooling Water Supply for Vapor Condensing Coils
6. Secondary Fluid Supply
7. Secondary Fluid Regulator Valve
8. Elevator Basket
9. Primary Water Temperature Switch (2 TAS)

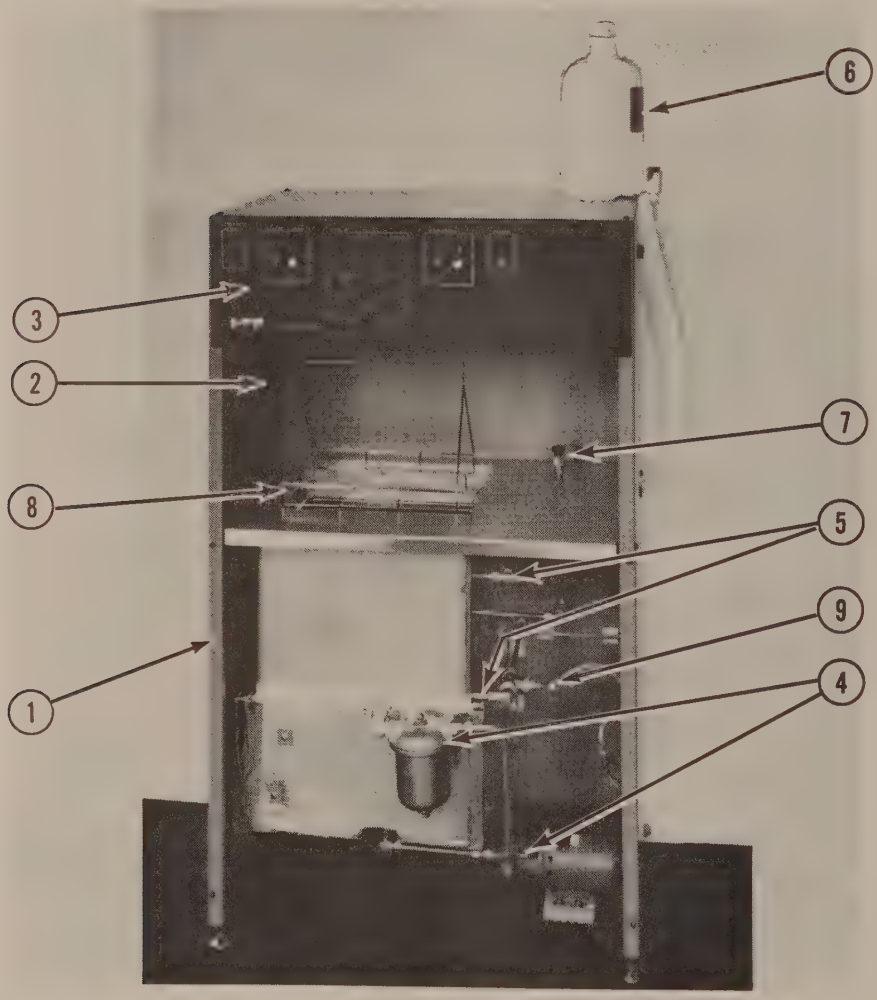

Figure 1-2 Model 912 Dual Vapor Soldering System

1. Elevator Drive Motor (2 MOT)
2. Basket Support Chains
3. Power Circuit Breaker (1 CB)
4. Control Power Fuse (1 FU)
5. Elevator Speed Control Fuse (2 FU)
6. Transformer Fuses (3,4 FU)
7. 230/115 VAC Step-down Transformer (1 T)
8. Heater Power Contactor (1 CON)
9. Proportional Power Controller (1 PC)
10. Grounding Bar (1 GR)
11. Elevator Motor Speed Controller (1 SC)
12. Idle Power Control (1 POT)
13. Step Programmer (1-6 SP)
14. Elevator False Start Relay (1 CR)
15. Heating Element Overtemperature Controller(1 TAS)
16. Step Programmer Limit Switch (1 LS)
17. Idle/Reflow Limit Switch (2 LS)

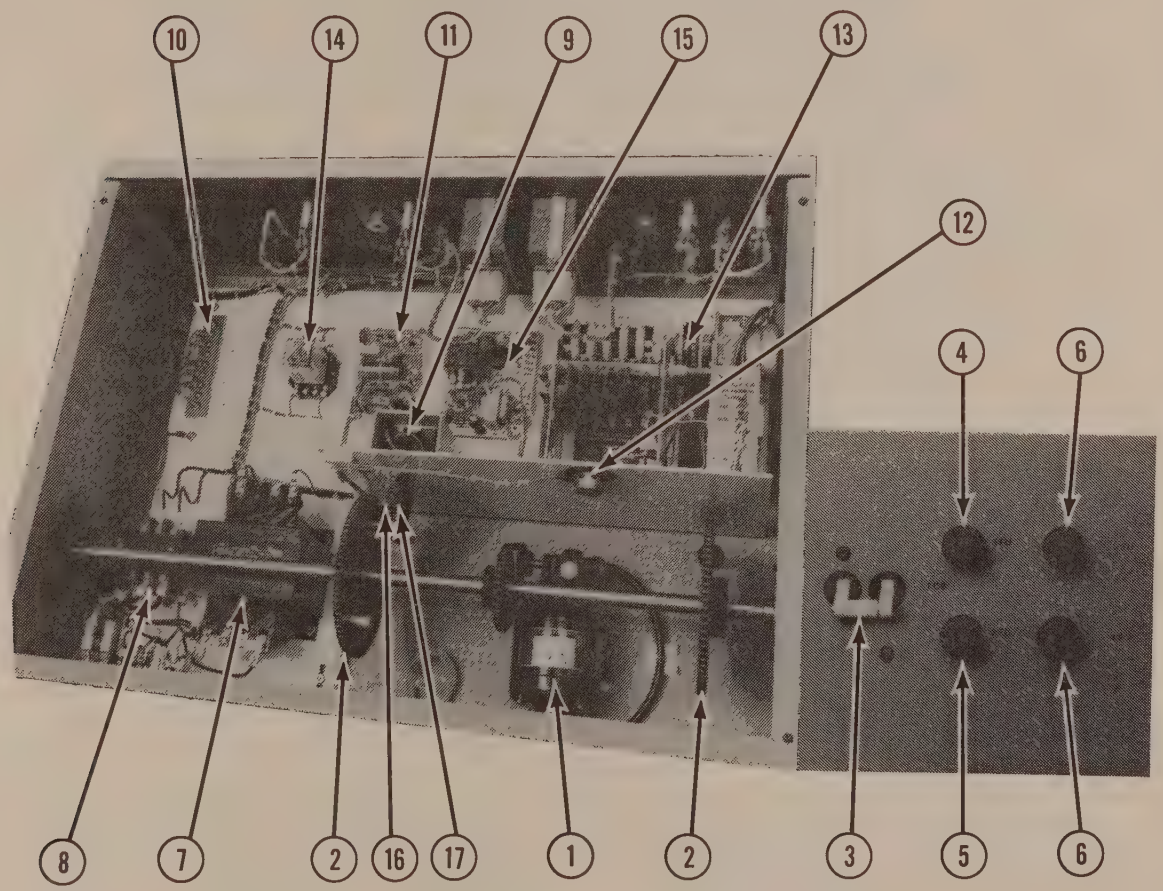

Figure 1-3 Elevator Housing/Power Control Subchassis

The primary fluid filtration system, located beside the tank (refer to Figure 1-4), consists of a 1/5 hp electric motor with a centrifugal pump (1) and a cannister-type filter unit (2). The only maintenance item in the fluid filtration system is to change the filter element inside the cannister on a regularly scheduled basis.

Those items comprise the auxiliary subsystems required to operate the Vapor Phase heating system. The heart of the system is a stainless steel tank with a heating element in the bottom. The electrical connections for the heater are exposed in holes in the one-inch-thick insulation that surrounds the bottom third of the tank.

1.2.2 FUNCTIONAL DESCRIPTION

1.2.2.1 HEATING SYSTEM

PRIMARY VAPOR BLANKET

The Dual Vapor Soldering System is essentially an open top stainless steel tank (see Figure 1-5). An electric heating element in the bottom of the tank heats the fluid in the sump to a boil, producing a volume of saturated vapor having the same temperature as the boiling sump. For the commonly used Fluorinert® FC-70, this is 419 degrees F (215 degrees C). It is this vapor that provides the energy for heating objects placed into it.

POWER CONTROL

The power level to the heating elements is controlled by a solid state full wave triac phase angle proportional controller. By varying the turn-on angle time, any power level from zero to full can be achieved. The function is performed by semiconductor thyristors incorporated into the circuit. The system does this with a proportional controller in which a selected control (gate) voltage triggers the switch ON when the current reaches that voltage.

Each setting for the VAPOR RATE control varies the triac phase firing angle to conduct current in proportion to the control setting, thus determining power output. Under production load conditions, more power is needed to heat product mass than is required to maintain steady state idle conditions. Therefore, the VAPOR RATE control is set to as low a level as possible and still maintain desireable reflow as determined by process requirements.

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1. Electric Motor With Centrifugal Pump
2. Cannister Type Filter Unit
3. Filter Air Bleed Screw
4. Primary Water Temperature Switch (2 TAS)

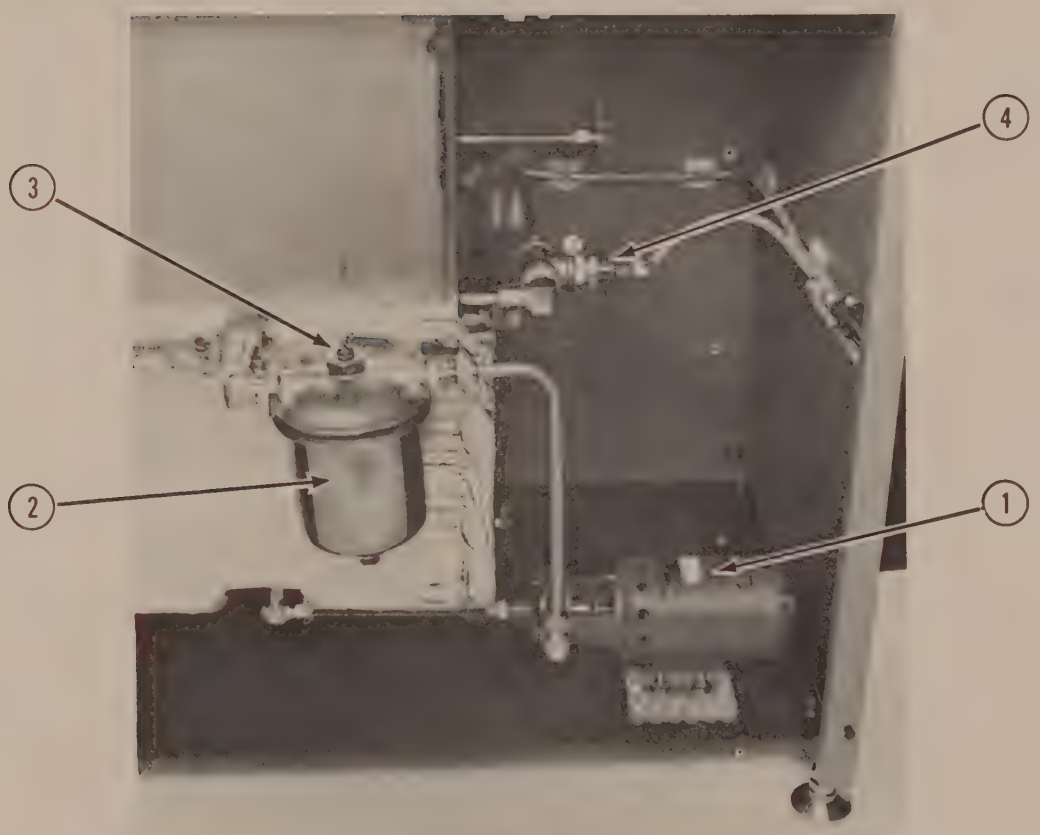
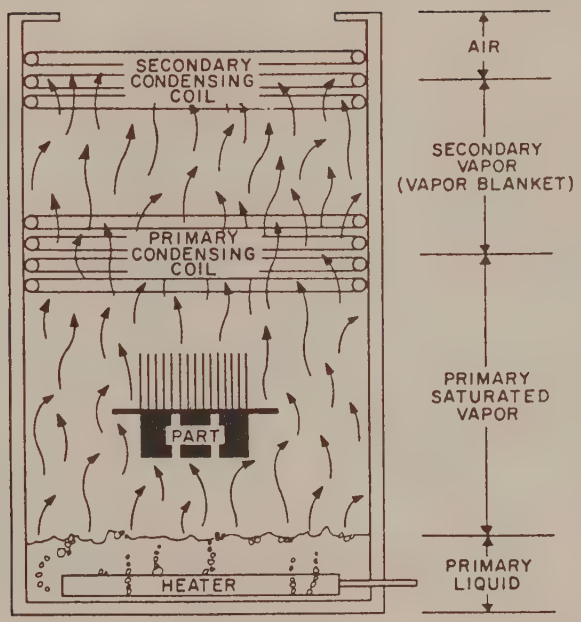


Figure 1-4 Primary Fluid Filtration System



(FIGURE COURTESY OF WESTERN ELECTRIC COMPANY, INC.)

Figure 1-5 PHASE-FOUR Dual Vapor Soldering System

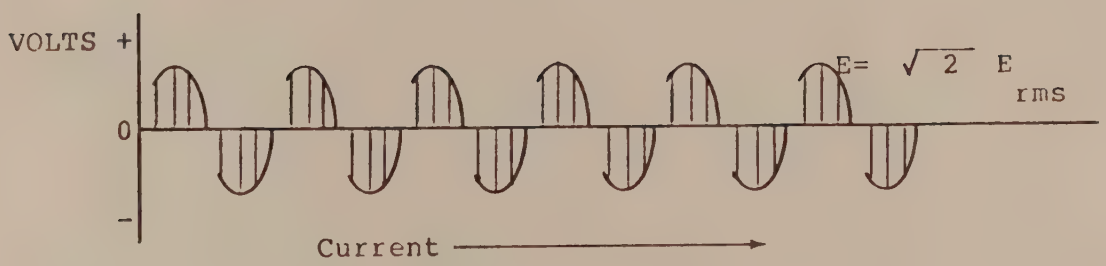


Figure 1-6 Power Control By Proportional Controller Switching

SECONDARY VAPOR BLANKET

The secondary vapor blanket is set up by vaporization of a small amount of R113 fluid (trichlorotrifluoroethane) which, being less dense than the primary fluid, floats on the surface. As the primary fluid is heated, the R113 vaporizes at 118 degrees F (48 degrees C). The secondary vapor is lighter than the primary vapor but heavier than air. This secondary blanket - soon superheated to 185 to 225 degrees F (85 to 107 degrees C) by the primary blanket beneath - is maintained over the primary vapor to minimize loss of the costly primary fluid to the atmosphere.

Once established, the primary blanket is held down at the level of the primary condensing coil. Water between 100 and 120 degrees F (38 and 49 degrees C) enters the coil. Since the R113 secondary fluid boils at 118 degrees F (48 degrees C), only the primary vapor will condense on the primary coil. This condensate then drops into the boiling sump. The primary condensing coil, then, physically defines both the upper limit of the primary vapor and thereby the lower limit of the secondary blanket.

Under production load conditions, more power is needed to heat the product mass. Therefore the REFLOW power control is set at a higher level than the IDLE power control (determined by experience) and this increased power is switched on and off as needed by the control circuitry.

The top of the secondary blanket is maintained up to the level of the secondary coil by adding small amounts of R113 secondary fluid to offset losses to the atmosphere. Tap water at 45 to 65 degrees F (7 to 18 degrees C) enters the coil to create a cool zone that condenses secondary vapor and defines the upper limit of this protective blanket. The R113 condensate falls back into the tank and is revaporized to maintain the secondary blanket.

If there were no R113 loss to the atmosphere, there would be no need to add R113 fluid. However, there are normal losses. A metered flow of R113 from the external container maintains the working supply; adjustment of the outlet regulator on the loading table controls the R113 flow rate.

1.2.2.2 MECHANICAL SYSTEM

ELEVATOR

The elevator transport system lowers and raises product in a controlled, repeatable manner. The basket, a welded stainless steel wire grid, is suspended from a pair of roller chains which pass over sprockets located in the elevator housing.

The sequence of events in a single cycle (Refer to Appendix B Electrical Schematic) is as follows:

- Depress the START cycle pushbutton on the control panel. This advances the step programmer to Step 2 or 12.*
- The drive motor turns the driven sprocket.
- The home cam on one chain sprocket releases the step programmer limit switch (1 LS) and the idle/reflow limit switch (2 LS). Reflow power is now activated.
- The basket slowly descends from its home position at the elevator table into the secondary vapor zone.
- The dwell cam actuates limit switch 1 LS momentarily, advancing the step programmer to Step 3 or 13. The basket descends nonstop through the secondary vapor zone into the primary heating zone.
- Basket descent continues into the primary zone until the reflow cam actuates 1 LS: the programmer advances to Step 4 or 14; the motor stops; the reflow timer starts; and reflow power continues.
- When the reflow timer "times out," it advances the programmer to Step 5, reversing the drive motor and starting the basket upward.
- Basket ascent continues until the dwell cam actuates 1 LS, advancing the programmer to Step 6 or 16. The drive motor stops and the secondary dwell timer starts.
- After the secondary dwell timer "times out," it advances the programmer to Step 7 or 17, which restarts the drive motor and the elevator basket is raised to its home position.
- As the basket approaches home position, the home cam actuates 1 LS and idle/reflow limit switch 2 LS and the programmer arrives full cycle at the start position (Step 1 or 11). The elevator stops and the heater power switches from reflow to idle.

FILTRATION

During normal system operation, dirt, debris, flux, and other impurities will accumulate in the primary fluid. A centrifugal pump with a 10-micron mechanical filter is provided to remove this foreign material from the fluid. Regu-

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* The programmer has 20 steps per revolution. Therefore one revolution will contain programs for two machine cycles.

lar filtration at the end of each operating day prevents accumulation of char deposits on the heating surfaces and potential subsequent decomposition of the primary fluid.

PRIMARY WATER INLET CONTROL

Water entering the primary cooling coil should be between 100 and 120 degrees F (38 and 49 degrees C). Hot water exiting the coil should be between 160 and 180 degrees F (71 and 82 deg C). Adequate flow must be maintained to ensure that primary water exiting does not exceed 200 degrees F (93 deg C), the actuation point of the water temperature thermostatic switch (2 TAS).

If actuated, 2 TAS switches off heater power until the water exiting the primary condensing coil decreases to less than 200 degrees F (93 deg C). (See 6.0 Troubleshooting.)

1.2.3 OPERATING DESCRIPTION

The operating control panel (see Figure 1-7) controls the electrical functions required to operate the system. (To establish the vapor zones, refer to 3.1 Start Up.) The status of the switches, controls, and indicators at the start of operation is listed in Table 1-1:

Table 1-1 Control Panel Initial Settings And Indicator Conditions

Function	Condition	Indicator	Condition
CONTROL POWER Switch	ON	Amber	Lighted
VAPOR RATE Switch	ON	Amber	Lighted
ELEVATOR Switch	ON	Amber	Lighted
ELEVATOR Speed Control	5 (nominal)		
FILTER Switch	OFF	Amber	OFF
Reflow Timer	30 sec (initial setting)		
Secondary Dwell Timer	45 sec (initial setting)		
VAPOR RATE Reflow Control	7 (initial setting)		
Idle Rate Control (On Power Control Subchassis)	6 (initial setting)		

1. CONTROL POWER Switch (1 S)
2. CONTROL POWER Indicator Lamp (1 LT)
3. VAPOR Power Switch (2 S)
4. VAPOR Power Indicator Lamp (2 LT)
5. Reflow RATE Control (2 POT)
6. Reflow Timer (2 TRE)
7. START Cycle Pushbutton(1 PB)
8. Secondary Dwell Timer (1 TRE)
9. ELEVATOR Switch (4 S)
10. ELEVATOR Power Indicator Lamp (4 LT)
11. ELEVATOR Speed (3 POT)
12. FILTER Power Switch (3 S)
13. FILTER Power Indicator Lamp (3 LT)

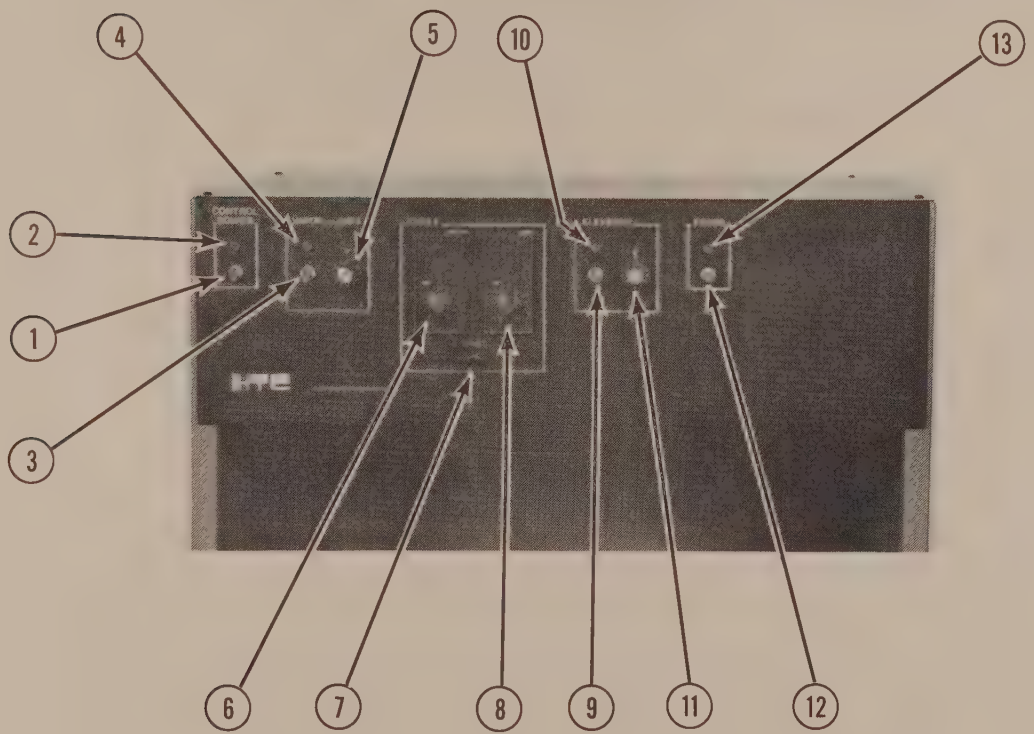

Figure 1-7 Control Panel

The following steps describe the PHASE-FOUR system functions in relation to the operating cycle.

1. BASKET IS LOADED.

   - The operator loads product onto the basket and depresses the START CYCLE pushbutton.

   - The motor and reflow power are activated.

2. BASKET IS LOWERED INTO THE HEATING ZONE.

   - The basket travels down through the secondary vapor zone into the primary heating zone.

3. PRODUCT IS HEATED.

   - The basket stops at the reflow position,

   - The REFLOW timer starts and the timing indicator lights,

   - The product is heated by condensation of the saturated primary vapor and the solder melts (reflows). The time in REFLOW varies according to the particular product characteristics (from 5 to 45 seconds or more).

   - The REFLOW timer "times out," and

   - The basket rises (at the same rate as that of the descent).

4. BASKET IS RAISED INTO SECONDARY VAPOR ZONE.

   - The basket stops in the secondary vapor zone,

   - The secondary dwell timer starts,

   - Primary condensate on the product is rapidly evaporated by residual heat in the product,

   - The solder cools and solidifies,

   - Product continues to cool (time in secondary dwell is dependent on product configuration and mass; all condensate should run off or evaporate before the secondary dwell period ends),

- Secondary dwell timer "times out," and
- The basket rises.

5. CYCLE ENDS.
   - The basket stops at the home position,
   - Product is ready for removal from the basket.

1.3 SPECIFICATIONS

Operating Temperature	Up to 490 degrees F (254 deg C), depending on fluid selected
Product Size	9 x 12 in. (228.6 x 304.8 mm) max.
Product Weight	2 lb (0.9 kg) max. (including fixtures and supports, but not the basket)
Physical Dimensions	Length: 29.0 in. (73.7 cm) Width: 36.5 in. (92.71 cm) Height: 46.0 in. (116.8 cm) Loading table: 25.5 in. (64.8 cm) high
Power Requirement	230 VAC, 20 AMPS, 1-phase, 60 Hz (50 Hz may be specified)
Connected Load	Standard system: 3.6 KW
Heating Element	Resistive element with Stainless steel-sheath immersion type heaters.
Heater Power Control	Input power regulated with zero crossover power controller
Primary Fluid Volume	Standard 3.6 KW system: 26 lb (12.0 kg) nominal
Secondary Fluid Volume	4-6 oz (118-177 ml) nominal
Filtration System	30 minutes daily recommended Filter element - 10 micron, cotton Filtration Pump - Centrifugal, Type 316 stainless steel, Maximum filtration operating temperature: 300 degrees F (149 deg C) Pump Motor - Totally enclosed, 1/5 hp, 115 VAC, 1 phase, 60 Hz (50 Hz if specified), 2.6 amp Piping - In-tank condensing coils and filtration system: Type 316 stainless steel with fittings

Reflow Vessel	Material: 304 stainless steel
Water Supply System	Secondary coil: 2 gal/min minimum (7.6 liter/min), city or treated water at 45-65 degrees F (7-18 deg C) at inlet
	Primary coil: 1 gal/min minimum (3.8 liter/min), city or treated water at 100 to 120 degrees F (38 to 49 deg C) at inlet
	Pressure: 60 PSIG (4.1 atmos) recommended; 100 psig (6.8 atmos) maximum
	Piping: Cooling water system (outside of tank): 1/4 NPT female connections to source
Ventilation Port	15.62 x 2 in. (39.7 x 5.1 cm) port on rear surface of elevator housing
Exhaust Ventilation	User-supplied system: 217 cfm (102 liter/sec) as measured at system ventilation port to provide face velocity of 100 ft/min (30.5 m/min) across elevator housing opening
Paint Finish	Sherwin-Williams Polane® blue medium texture epoxy
Shipping Weight	Approximately 250 lb (114 kg)
Safety Standards	Meets all applicable OSHA, Federal and State standards for environmental and operator safety

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1.4 CONTROLS AND INDICATORS

Each electrical device is identified by an alphanumeric designation at its respective subchassis location to facilitate troubleshooting with the schematic in Appendix B. Those same designations are given after each control and indicator listed below.

1.4.1 CONTROL PANEL
(Refer to Figure 1-7.)

CONTROL POWER Switch (1 S) Lamp (1 LT)	Supplies control voltage to the entire system (including the elevator but not to the filtration pump)
VAPOR Power Switch (2 S) Lamp (2 LT)	Turns on power to the heating element
VAPOR RATE Control (2 POT)	Potentiometer control marked 0-10, determines reflow power level from 0-100% to the heating element
	NOTE Power settings are relative and nonlinear, with 0 minimum power and 10 maximum power.
CYCLE REFLOW Timer (2 TRE)	Multirange: 0 to: 0.1 sec, 10 sec, 1 min, 10 min, 1 hr, 10 hr; determines dwell in the primary vapor zone
CYCLE DWELL Timer (1 TRE)	Multirange: 0 to: 0.1 sec, 10 sec, 1 min, 10 min, 1 hr, 10 hrs; determines dwell in the secondary vapor zone
START Cycle PB Switch (1 PB)	Starts automatic cycle
ELEVATOR Switch (4 S) Lamp (4 LT)	Turns on power to elevator system
ELEVATOR Speed Control Control (3 POT)	Potentiometer control marked 0-10, determines rate of basket travel from 0-48 in./min (0-122 cm/min) approx.
FILTER Switch (3 S) Lamp (3 LT)	Turns on power to the filtration pump (independent of control power)

1.4.2 POWER CONTROL SUBCHASSIS
(Refer to Figure 1-3.)

High Element Temperature Controller Control (POT/1 TAS)	Potentiometer control marked 0-10, determines element surface temperature at which controller shuts down vapor power (set at first start up)
Idle Power Control (1 POT)	Potentiometer control marked 0-10, determines idle power level from 0-100% to the heating element

1.4.3 REAR PANEL
(Refer to Figure 1-3 again.)

Power Circuit Breaker (1 CB)	2-pole, 25 amp
Control Power Fuse (1 FU)	Slow acting, 5 amp
Elevator Speed Control Fuse (2 FU)	Fast acting, 1.5 amp
Control Transformer Fuse (3,4 FU)	Slow acting, 3 amp

1.4.4 LOADING TABLE
(Refer to Figure 1-2.)

R113 Secondary Fluid Regulator	Needle valve, controls rate of R113 flow from external supply into tank

1.4.5 LOWER ENCLOSURE
(Refer to Figure 1-4.)

Water Temperature Switch (2 TAS)	Enclosed temperature switch located at outlet of primary cooling coil, activates at 200 degrees F (93 degrees C) (vapor power will turn off)

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2.0 INSTALLATION

2.1 INITIAL SETUP

NOTE

If any visible shipping damage has occurred, notify the carrier who delivered the system. Save all packing materials for possible insurance inspection. Inform HTC of the damage for service records and to determine if operation of the system will be affected.

2.1.1 UNPACK AND LEVEL THE SYSTEM

1. Move the unit to its intended plant location. Cut the bands and remove the shipping carton.

2. Remove the accessories from the shipping carton. These include:

   - Four screw-leveling pads,
   - Elevator basket,
   - Lid for the tank,
   - Secondary fluid supply bottle with flexible connecting line, and

3. Remove the unit from the pallet and place in position.

4. Screw the four leveling pads into the frame legs. (Lift or tilt the unit carefully.)

NOTE

A metal drip pan may be placed under the entire Dual Vapor system to catch inadvertent spills.

5. Check the level of the loading table. (See Figure 2-1.) Make any necessary adjustments and recheck to assure accurate leveling of the unit in both directions..

2.1.2 INSTALL THE BASKET

1. Remove the tape securing the basket support bar from the underside of the elevator housing. Ensure that the bar hangs freely from the two elevator chains.

2. Hang the basket from the support bar.

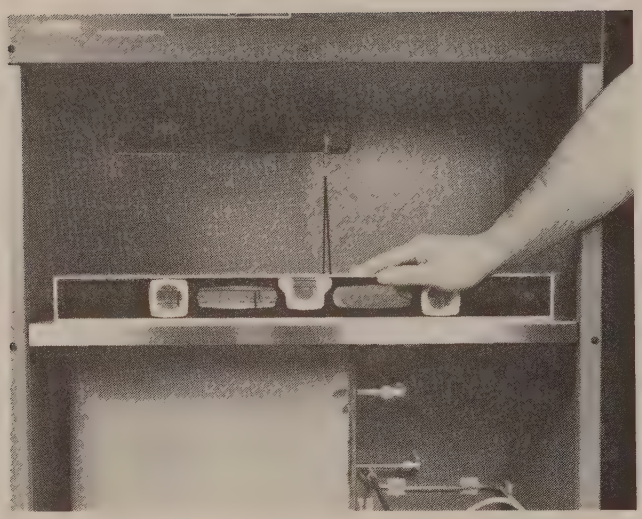

Figure 2-1 Level Check

2.2 EXTERNAL UTILITY REQUIREMENTS

Refer to Appendix A Installation Drawing for system dimensions and service locations.

2.2.1 POWER

The system should be connected to a 230 VAC, 60 (or optional 50) Hz, 1-phase power supply through a customer-supplied fused disconnect of appropriate size. (See Table 2-1 Power Requirements.) Connect the wiring from the fused disconnect directly to the three-wire Type SO cable supplied. The cable is attached to the correct terminals inside the machine. Green is equipment ground. Check the machine data label located near the power cable for this system's power requirements.

System wiring practices and designations follow JIC codes (which may be used for reference). The following are standard: Refer to Appendix B, Electrical Schematic.

BLACK	All high voltage wiring and 115VAC wiring from the hot side of the step-down transformer to the hot side of the CONTROL POWER and FILTER switches
RED	All control voltage from the low side of the CONTROL POWER switch not at ground level potential
WHITE	Control circuit ground (chassis ground)
GREEN/YELLOW	Chassis ground (transformer secondary ground to chassis)
DARK BLUE	DC voltage
LIGHT BLUE	Trigger signal
YELLOW	Thermistor DC signal voltage

TABLE 2-1 POWER REQUIREMENTS

	*STD			*STD	
Voltage	200	208	220	230	240
Power (KW)	3.8	4.0	3.4	3.8	4.1
Line Amps	19.0	19.5	25.5	16.5	17.0
Phase	1	1	1	1	1
Hertz	50/60	50/60	50/60	50/60	50/60

*Standard System

2.2.2 WATER

The Dual Vapor Soldering System has two water-cooled vapor condensing coils inside the tank. Proper operation requires that the lower (primary) coil receive water at the rate of 1 gal/min (3.8 liter/min) (maximum) and at a temperature of at least 100 degrees F (38 degrees C). The upper (secondary) coil can use 45-65 degree-F (7-18 degree-C) tap water flowing at 1-2 gal/min. If these water loop returns are to be connected to a common drain, use a check valve in each outlet to prevent back-flow into either coil.

HTC recommends that external shutoff valves be installed in all water supply lines. This will simplify later start up and shutdown operations and minimize flow adjustment requirements.

Table 2-2 summarizes the water requirements and the connector types on the Dual Vapor system. (Also see Figure 2-2.)

TABLE 2-2 WATER REQUIREMENTS

	Temperature	Fitting	Material	Flow Rate
Primary Coil				
Supply[a]	100-120 F (38-49 C)	1/4 NPT female inlet & outlet	Brass	1 gal/min.[b] (max.)
Outlet	160-180 F (71-82 C) (nominal)			Drain open or closed[c]
Secondary Coil:				
Supply[a]	45-65 F (7-18 C)	1/4 NPT female inlet & outlet	Brass	1-2 gal/min (nominal)
Outlet	60-80 F (16-27 C) (nominal)			Drain open or closed[c]
Pressure:	60 psig (4.1 atmos) recommended; 100 psig (6.8 atmos) maximum			

a. Flow meter and shutoff valve are recommended customer-supplied options.
b. Water flow must be great enough to prevent outflow from turning to steam.
c. Check valve (customer-supplied) should be used to block possible back-flow when both drains are common.

1. Secondary Cooling Water Outlet
2. Secondary Cooling Water Inlet
3. Primary Cooling Water Outlet
4. Primary Cooling Water Inlet

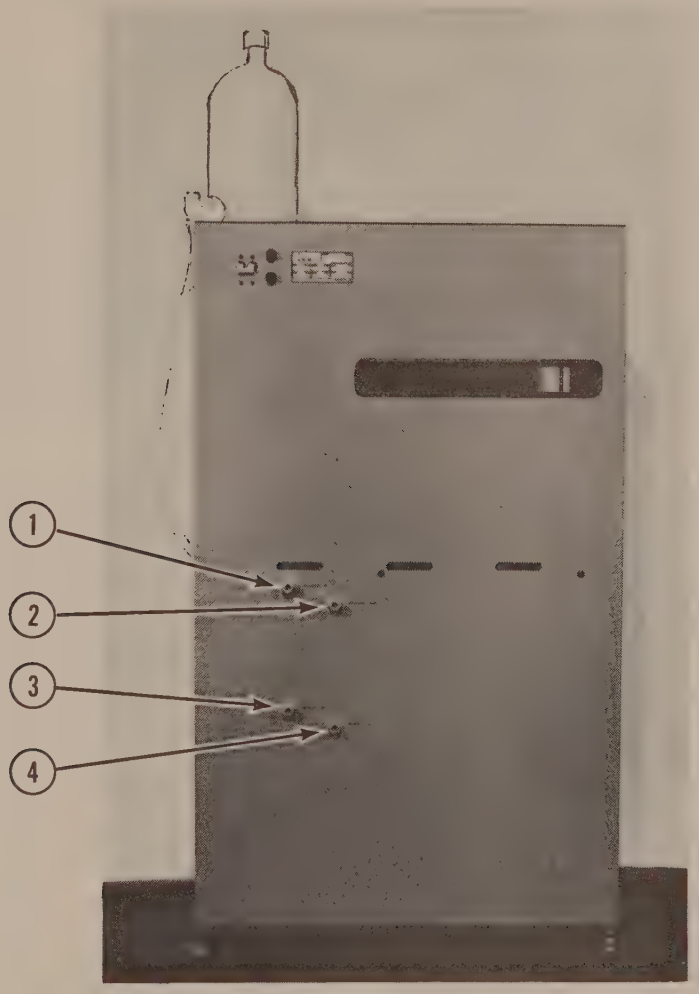

Figure 2-2 Cooling Water Connections

2.2.3 EXHAUST VENTILATION

DANGER

Toxic byproducts may be produced by the Vapor Phase soldering system. Care must be taken to avoid inhalation of any vapor from the system. Smoking and eating should be prohibited in those areas where this equipment is installed. Wash hands thoroughly before touching food, cigarettes, or other consumable items.

Every Vapor Phase unit requires a ventilation system (customer-supplied) that will exhaust to the outside all vapors emanating from the system. These include any vapors from primary and secondary fluids and flux fumes from the product after it returns to the loading (HOME) position.

A 15.62 x 2 in. (39.7 x 5.1 cm) ventilation port is provided on the upper rear wall of the elevator housing. Many types of prefabricated transition manifold ducts are commercially available and adaptable to the 912 ventilation port. The duct must be securely mounted to the rear elevator housing wall.

The exhaust flow should be sufficient to establish a face velocity of 100 ft/min across the opening of the elevator housing. For the Dual Vapor system, this should be 217 cfm (102 liter/sec). (Losses between the blower and the system must be considered when selecting ventilation blower.)

The blower must operate from initial start up through shutdown and filtration. There should be an interlock (customer-supplied) to prevent system heating when the blower is off for any reason.

2.3 FLUID FILL

CAUTION

Read this information before starting. The sequence of steps is important for safe, economical, and efficient Dual Vapor system operation.

To make setup and operation easier to follow, use a copy of the relevant CHECKLIST in Appendix F to mark off each step as it is executed. Later on, when the procedures become routine, the CHECKLISTS should always be available near the unit as convenient memory joggers.

If you have any questions regarding these setup and operating instructions, or the technical reasons for them, please feel free to call the HTC After Order Support (AOS) representative at (617) 369-1110 in Concord, MA.

2.3.1 PRIMARY FLUID

CAUTION

Check all pipe fittings and heating element through-tank connections for fluid leakage. Failure to observe this essential precaution can result in loss of costly primary fluid. HTC will not be responsible for any fluid loss resulting from leaking fittings.

Although every care is taken to ensure that all fittings are correctly tightened during manufacturing, there is no way to guarantee that they may not be loose at the time the system is installed. Inspect all pipe fittings (including the filter housing) and heating element through-tank fittings prior to initial fill. Remove any debris that may have fallen into the tank and vacuum the inside carefully.

Fill the main tank with at least 20 pounds (9.1 kg) of primary fluid. Turn on the FILTER switch on the control panel to fill the filter lines and the filter cannister. Normally the pump will prime after turning the FILTER switch ON and OFF (20-30 seconds in each position) several times.

If the pump does not prime in a reasonable time, the air will have to be bled at the bleeder screw on the top of the filter housing (see Figure 1-4 Filtration System). When the fluid flows freely from the tank return line, turn OFF the FILTER switch and check all the fittings and through-tank heater connections for possible leakage.* Retighten fittings showing any evidence of leakage.

---

* If the primary material is not liquid at room temperature, the system will have to be warm before the pump can be primed and the piping, etc., checked for leakage. Refer to 3.1.5 for heat start up procedure.

Check the fluid level in the tank. The use of a flashlight beam through the fluid will make it easier to judge how much fluid is covering the highest heating surface. If there is less than one inch of fluid over the highest heating surface, add more primary fluid, i.e., add enough to cover all heating surfaces by at least one inch. Losses of primary fluid are not affected by an excess in the initial fill; from the standpoint of proper and safe operation, it is well to consider having more than the minimum fluid in the sump for continuous operation.

NOTE

Be sure to check fittings and through-tank connections again after starting the system for the first time and continue to observe during the first days of operation for any evidence of leakage. Retighten any loose fittings.

2.3.2 SECONDARY FLUID

The R113 secondary fluid reservoir is positioned on the right side of the unit. (Refer to Figure 1-2.) This external source of R113 should be connected to the secondary fluid regulator valve (7) before startup. The external container should be vented to prevent air-lock. Close the shutoff valve and fill the container with R113 fluid in readiness for initial startup. Add a quantity of R113 secondary fluid on top of the primary fluid in the tank. About 4-6 oz (118-177 ml) of R113 is recommended to establish the secondary vapor blanket. Now turn on the two cooling water supplies and set up the vapor zones according to the system startup procedures listed in 3.1.4 Cooling Water and 3.1.5 Set Up Vapor Zones. After the system has stabilized, open the reservoir shutoff. Then open the R113 regulator valve 6-8 turns. Observe the dripping condensate on the secondary coil. Adjust the regulator in quarter-turn increments every five minutes (to allow system stabilization time) until the R113 condensate drips from just the lowest secondary cooling coil.

After the vapor blankets are established, the interface between the primary and secondary blankets will be visible as a mist around the lowest primary condensing coil with condensate dripping steadily from the coil. Condensate dripping from the lower section of the secondary coil (the inlet end) is the only visible indication of the top of the secondary blanket. (Refer to 3.3 Optimize Settings for a complete description of the vapor blankets.) The Dual Vapor Soldering System is now ready for production processing.

3.0 OPERATION

3.1 START UP

WARNING

Operating instructions must be followed carefully for safe conditions. Incorrect operation of this equipment can result in generation of toxic byproducts which may be harmful. Copies of checklists from Appendix G should be used by operating personnel to insure consistent procedures.

CAUTION

Only qualified personnel should attempt to operate and perform maintenance on the Vapor Phase system.

The procedure below should be followed explicitly for each daily start up.

3.1.1 EXHAUST VENTILATION

The ventilation system must be activated before system start up. It should continue right through shutdown and filtration. Ensure that air flow is sufficient for a minimum 100 ft/min (30.5 m/min) face velocity at the face of the elevator housing.

3.1.2 PRIMARY FLUID

Remove the tank lid from the loading table. Ensure that the system, including the filter and piping, has been filled with primary fluid as directed in 2.3 Fluid Fill. At all times the primary fluid level should be at least one inch above the highest heating element surface.

CAUTION

Do not inhale vapor from the tank. The R113 vapor can cause minor short-term discomfort. Use a mirror to observe inside of the tank.

CAUTION

Failure to maintain minimum primary fluid level can result in over-heating of some primary vapor and subsequent breakdown of the primary fluid material into potentially harmful byproducts.

3.1.3 SECONDARY FLUID

Check the external secondary fluid supply. If the vessel is less than half full, refill it before continuing. The R113 add requirement for daily start up is covered by Step 3.1.5, below.

3.1.4 COOLING WATER

Turn on the water supplies to both the primary and the secondary cooling coils. Ensure that the water is actually flowing through the coils at the normal flow rates. (See Table 2-2 Water Requirements.) Inspect all water pipes for leakage.

3.1.5 SET UP VAPOR ZONES (Daily Start Up)

The following sequence takes only a minute to execute. Heat-up will require an additional 20-25 minutes.

WARNING

Always wear eye protection, gloves, and long-sleeved clothing as protection against possible splattering and hot surfaces.

1. Turn all switches OFF. Remove the tank cover. If present, remove the optional acid neutralizer/desiccant pouch. (Refer to Appendix J.)

2. Add 4-6 oz (118-177 ml) R113 secondary fluid to sump. (Must be added daily at start up.*)

---

* Most likely there will not be enough R113 in the system to establish a secondary vapor blanket at the start of each day. Evaporation could deplete the R113 that was in the tank during cool-down, fluid filtration, and the idle period.

3. Switch ON the main fused disconnect.

4. Switch ON CONTROL POWER - amber indicator lights.

5. Switch ON VAPOR power - amber indicator lights.

NOTE

On initial start up, heating element overtemperature controller must be set. (See section 3.3.4.)

6. Set the VAPOR RATE control at 10.

7. Switch ON ELEVATOR power - amber indicator lights. Depress the CYCLE START pushbutton and allow the elevator to go down one or two inches. Then turn OFF the ELEVATOR power switch.

8. After about 10 minutes, the secondary vapor cloud forms at the primary condensing coil. When the interface cloud begins to recede toward the sides (in 10 to 15 minutes) open the R113 secondary fluid regulator.

9. Ensure that the R113 secondary vapor condensate starts to drip steadily from the lower secondary condensing coil and that the secondary fluid reservoir is filled to the proper level. If necessary, open (or close) the R113 secondary fluid regulator one-eighth turn every five minutes until there is steady dripping from the lower end (inlet end) of the secondary condensing coil is observed. This will be the only visible evidence of the proper level of the secondary blanket.

10. After 30 minutes, turn ON ELEVATOR power switch and set the VAPOR RATE at 7 (or the setting determined by process requirements).

11. Depress the CYCLE START pushbutton. Allow the elevator to complete one cycle.

12. Ensure that REFLOW and secondary DWELL timers are at normal settings (based on process requirements).

13. Set the ELEVATOR speed at 5 (nominal).

NOTE

Idle power should be set at initial start up. There should be no need to reset after that.

14. Turn idle power down to 6 or 7 and wait a few minutes. Reduce the idle power setting by one increment every few minutes until the primary blanket begins to recede. (The steady dripping from the primary condensing coil will stop.) Then raise the IDLE POWER setting by one number to just maintain the primary-secondary vapor interface at the primary condensing coil (steady dripping from the coil and center area clear). An idle power setting of about 5 or 6 should be adequate.

15. Load the elevator basket and depress the START pushbutton to start the cycle.

16. The ELEVATOR speed setting may be increased until the basket reaches a rate of three to four feet per minute. If turbulence is observed as the basket moves through the zone interfaces, reduce the speed setting.

CAUTION

Do not inhale vapor from the tank. The R113 vapor can cause minor short-term discomfort. Use a mirror to observe inside of the tank.

17. Observe the condensate dripping from the primary cooling coil during production cycles. Reduce VAPOR RATE one number each cycle until there is less primary condensate observed dripping from the first turn of the primary coil during the reflow period. Then increase the RATE setting slightly to stabilize the system. This setting may change depending on product size.

Table 3-1 lists the visual indications of vapor blanket conditions.

TABLE 3-1 VAPOR BLANKET CONDITIONS

	Low	Normal	High
SECONDARY (Controlled by metered R113 fluid inflow)	No drip from secondary condensing coil	STEADY DRIP EVERY INCH OR TWO ALONG THE INLET END OF THE COIL	Heavy drip from secondary condensing coil
	Little or no drip from R113 supply return	STEADY DRIPPING FROM R113 SUPPLY	Steady stream from R113 supply
			Heavy cloud depressed below primary coil, turbulence, table top surface hot to touch
VAPOR TEMPERATURE	<185 degrees F (<85 degrees C)	185-225 degrees F (85-107 degrees C)	300-370 degrees F (140-188 degrees C)
PRIMARY (Controlled by power input)	No mist or minimal mist under primary coil	MIST ROLLING OFF LOWER TURNS OF PRIMARY COIL CLEAR VIEW OF BOILING SUMP	Sump obscured by billowing cloud at or even above primary coil
	No condensate on primary coil	CONDENSATE DRIPPING FROM PRIMARY COIL	

3.2 SYSTEM OPERATION

WARNING

Always wear eye protection, thick heat-resistant gloves, and long-sleeved clothing as protection against possible splattering and hot surfaces. The product and elevator basket are still quite hot at the end of an operating cycle. Care must be taken in removing product from the basket. The product may remain on the basket for further cooling before removal.

With product loaded onto the elevator basket at home position and the ELEVATOR switch ON, depress the START pushbutton. The elevator will lower the basket to the reflow position in the primary vapor zone. The REFLOW timer "times out" and the cycle advances to the secondary dwell. There, the secondary dwell timer determines the drying/cooling period before the basket returns to home position.

3.3 OPTIMIZE SETTINGS

Most of the settings on the Vapor Phase soldering system are self-explanatory. However, the guidelines in the following paragraphs should be considered for most effective operation.

WARNING

Dangerous voltages exist on the various printed circuit boards in this system. Contact with components and/or printed circuitry could cause serious injury or fatality. A nonmetallic screwdriver should be used when adjusting the trim pots to avoid any possibility of the screwdriver blade contacting live circuitry and shorting the circuitry or allowing contact with any dangerous or fatal voltages.

CAUTION

Do not try to rush processing with higher power settings. The extra power won't increase the temperature of the primary vapor, but it will cause excessive heat in the secondary blanket and reduce depth of the primary vapor blanket.

3.3.1 IDLE POWER

Idle power should be stable once the vapor blankets have been established. (Refer to 3.1.5 Set Up Vapor Zones.)

3.3.2 REFLOW POWER

Operation of the Vapor Phase system requires only that the vapor generation rate (determined by power input) equal the rate of condensation on the product going into the system. For this system, set the VAPOR RATE at 7 (or at the setting previously determined by process requirements. Run production. Any changes in the operating system should first be made in the REFLOW timer and ELEVATOR speed settings. Refer to 3.3.5 Reflow Time and 3.3.8 ELEVATOR speed. Only after optimum elevator speed and reflow timer settings have been achieved should the VAPOR RATE be reduced for maximum operating economy.

3.3.3 SECONDARY VAPOR BLANKET CONTROL

Proper inflow of R113 secondary fluid from the external supply should be set to maintain the secondary vapor at the level of the secondary cooling coil when the system is at idle power. Too little 113 fluid inflow will result in loss of the secondary vapor blanket and the primary vapor will rise out of the tank. With idle and VAPOR RATE levels and R113 secondary fluid inflow set properly, vapor losses will be minimized. (See 3.1.5 above for R113 fluid inflow adjustment procedure.)

NOTE

The loading table surface is comfortably warm to the touch when the system is properly adjusted. A hot surface indicates excess R113 inflow or excess power to the heating elements. Corrective action is required.

Excess R113 will cause profuse condensation on the secondary cooling coil, as well as gross turbulence in the system. As the excess R113 pours into the tank, it is vaporized but the heavy stream falls well into the primary vapor before it is vaporized. As the lighter R113 vapor rises through the primary vapor, it becomes superheated, accelerating its decomposition. Also, a significant amount of the primary vapor becomes entrained and is carried upward into the secondary zone from which it is lost to the atmosphere.

If this undesirable condition is allowed to continue, the sheer weight of the superheated mixture of primary and secondary vapor will depress the primary vapor blanket below the primary cooling coil and may prevent reflow of product in the system.

3.3.4 HEATING ELEMENT OVERTEMPERATURE CONTROLLER

A sensor attached to the top of the highest heating element in the tank sump senses the temperature of its upper surface. In the event the fluid level in the primary sump falls below that point, or if the element becomes encrusted with rosin or other residues, the element surface temperature will rise and cause the element overtemperature controller to activate.

The temperature controller should be set while the system is in steady-state operation. Increase idle power to maximum. Rotate the black knob (located on 1 TAS) by its spindle fully clockwise (set point 10). The set point is now higher than the element sheath temperature. After two or three minutes:

- Reduce the set point by rotating the knob counterclockwise until the controller (1 TAS) activates.

  A "click" will be heard when the power contactor opens.

- Then increase the set point again very slowly (clockwise) until the power just comes on.

  The contactor will "clack" and the heater power will come on.

- Move the setting ahead about one-half point. This will be just above the normal operating temperature of the heater surface, or about 450 degrees F (218 deg C). If different Fluorinert liquids are used, the set point must be readjusted again by this same procedure.

  Any substantial temperature increase will cause the controller to activate, shutting off power to the heater.

3.3.5 REFLOW TIME

Required time in the reflow zone can only be determined experimentally while processing product. In most cases, if power is sufficient to maintain the primary vapor, reflow should occur within 10 to 45 seconds. The REFLOW timer is on the front control panel.

Since the vapor temperature is constant, longer immersion time cannot cause overheating. However, care must be exercised if a product is sensitive to the total time of immersion in the vapor.

3.3.6 SECONDARY DWELL TIME

Dwell time in the secondary blanket is determined by the time it takes the product to completely evaporate from itself all traces of the primary condensate carried into the secondary zone. There should be enough residual heat

in the product to accomplish this, especially if flat surfaces have been loaded on a slant to facilitate rapid condensate runoff.

This evaporation may generally be observed while the product is still in the tank; occasionally it will be necessary to inspect for traces of drag-out after exit from the system. Depending on the configuration of the product, secondary blanket dwell will normally be between 45 and 60 seconds (DWELL timer 1 TRE).

3.3.7 ELEVATOR POSITION

The actuation sequence of the REFLOW, HOME, DWELL, and IDLE/REFLOW limit switches is built into the system at the factory. If changes are desired to this standard sequence consult with HTC.

3.3.8 ELEVATOR SPEED

The rate of travel of the elevator basket should be low enough that the vapor blankets, particularly at the primary/secondary interface, are not appreciably disturbed. This is partly an economic consideration related to loss of primary vapor. In fact, the problems caused by too-rapid motion in the vapor zones are quite similar to those associated with excess R113 secondary fluid in the system. (Refer to 3.3.3 Secondary Vapor Blanket Control for the effects of turbulence on the blankets.)

Of greater practical concern is the effect of moving product of substantial mass too quickly into the vapor zone. A cool (room-temperature) mass entering the secondary zone of a too-finely-tuned vapor heating system can absorb heat faster than the system is prepared to replace it. The R113 blanket and even the primary blanket can momentarily "collapse." This will start pumping air into and out of the tank with each system cycle which, in addition to induced turbulence and associated fluid losses, can lead to incomplete reflow and potential loss of product reflow reliability.

Although these negative factors can be partly offset simply by increasing the REFLOW cycle time setting, the cost in excessive primary vapor loss is high. It is far better to run the elevator slower. A speed approaching two feet per minute is commonly used.

3.4 LOAD CONSIDERATIONS

3.4.1 PRODUCT LOADING

Multiple-loaded fixtures may be processed with care taken not to exceed the total weight limit of the system. Whether stacked vertically or horizontally, the loading should allow ample space between fixtures and product for free circulation of the vapor so that there will be proper and effective heating of the entire load.

The type of product being processed and the design and spacing of the load and fixtures affects the ability of the system to reflow properly. Always run trial loads before actual production runs to ascertain proper operational characteristics.

Complex shapes should be positioned so that condensate will run off freely. Consideration should also be given to slanting of flat surfaces to minimize primary fluid drag-out and shorten the secondary dwell time.

3.4.2 FIXTURES

Fixtures should be designed for minimum mass so that more power will be available in the system for productive work. The fixtures should be as OPEN in design as possible so that the vapor can easily pass around and through the fixtures to heat the product. Avoid cavities in the fixtures in which fluid can collect, or provide drain holes as required.

Fixtures may be made of light-weight, corrosion-resistant metal. Epoxy/fiberglass materials designed to withstand the temperature of immersion in the primary vapor may also be used.

3.4.3 FLUX UTILIZATION

The Vapor Phase system has been designed to work well with products that solder properly with RMA (rosin, mildly activated) flux. This material has up to 40 percent solids content. It is of great advantage to minimize the total amount of flux used in the system to reduce maintenance and ensure longer, trouble-free operation.

- USE RMA FLUX OR OTHER ROSIN FLUX WITH MILDER ACTIVATION.

- DO NOT USE HIGHLY ACTIVATED FLUXES.

- USE THE MINIMUM FLUX SOLIDS CONTENT POSSIBLE WHICH WILL STILL ACHIEVE SUITABLE SOLDERING RESULTS. VERIFY THIS BY EXPERIMENTATION.

DANGER

Flux entering the system must be dry and free of alcohol. Flux which is not dry may lead to solder splatter in some instances.

4.0 SHUTDOWN

NOTE

The end of a production run is NOT the end of the day for the Vapor Phase heating system! Schedule production so that 1-1/2 to two hours after the last shift are available to cool down the system and filter the primary fluid.

After the last product has been removed from the elevator basket, the following procedure should be initiated:

1. Turn OFF the SECONDARY ADD supply valve located on the external plastic reservoir.
2. Turn OFF the VAPOR power switch and set the VAPOR RATE control at zero.
3. Remove the elevator basket.
4. Place the lid over the table opening.
5. Set the Elevator Speed control at zero.
6. Turn OFF the ELEVATOR power switch.
7. Turn OFF CONTROL POWER switch.

WARNING

Do not operate the filtration system when fluid is above 300 degrees F (149 deg C). Serious damage to the pump seals can result.

8. WAIT about 45 to 60 minutes until the primary fluid temperature drops below 300 degrees F (149 deg C) before starting to filter the primary fluid. The time required to reach this temperature can be established by using a thermocouple probe placed in the sump fluid.

Filtration for the system will require 30 to 60 minutes, depending on the quantity of fluid and how much flux or other foreign material is in the sump. The criterion for correct filtration is the clarity of the primary fluid. Properly filtered fluid will be clear and exhibit a straw color. (See Appendix D, Cleaning Of Primary Fluid.)

NOTE

Heavy accumulations of congealed material on the fluid surface should be skimmed off manually. OBSERVE ALL SAFETY PRECAUTIONS when working over the tank.

CAUTION

The primary fluid must be filtered at the end of EACH DAY to prevent build-up of flux in the system.

9. At the end of filtration, turn OFF the FILTER switch.

10. Switch off the main fused disconnect and ventilation.

11. Shut off water to the primary and secondary condensing coils.

12. Hang the optional acid neutralizer/desiccant pouch inside the tank. (Refer to Appendix J for information on the use of acid neutralizer and desiccant materials.)

5.0 MAINTENANCE

5.1 SCHEDULED MAINTENANCE

Conscientious attention to operating procedures and daily filtration will simplify system maintenance. It is also important during the first few weeks of operation to check frequently for fluid leaks at all piping connections and heater through-tank fittings. After the system has "settled down," the intervals between checks and maintenance chores can be extended until production experience indicates the proper schedule. Table 5-1 is a recommended maintenance schedule.

Table 5-1. Scheduled Maintenance

		Ref.
Daily	- FILTER THE PRIMARY FLUID	4.0
	- Check the primary fluid level	2.3.1
	- Replenish secondary fluid supply	5.2
	- Check for leakage	2.3.1, 3.1.4
Weekly	- Check system for fluid leakage	2.3.1
	- Check primary fluid return flow into the tank at room temperature to verify that the filter is not clogged.[a] Change the filter if flow is weak.[b]	5.2.2
Monthly	- Inspect primary fluid filter	5.2
	- Check tightness of all high voltage electrical connections	5.3.1
	- Check power output 0-100%	5.3.2
	- Check operation of temperature sensors	5.3.3
Quarterly	- Lubricate elevator motor shaft	5.4
	- Tighten pulley and sprocket setscrews	5.4
Semi-annually	- Clean tank and cooling coils	5.5
	- Clean primary fluid[c]	5.5, App. D
	- Grease sprocket shaft bearings	5.4

Notes:
a. FC-71 or equivalent fluids will not flow at room temperature. Refer to Sections 2.3.1 and 3.1.5 for preheating procedure.)
b. Check the filter frequently to establish an appropriate production interval for filter cartridge change.
c. Remove all primary fluid from the system before cleaning the tank and coils.

5.2 FILTRATION SYSTEM

The filtration system should be checked frequently during the first days of operation, along with the various other through-tank connections, for any signs of fluid leakage. Loose fittings should be tightened and watched carefully to ensure that no further leakage occurs. Thereafter, weekly inspection should be adequate.

5.2.1 DAILY FILTRATION

After each day's production, the primary fluid should be filtered* to remove accumulated flux and other foreign material. Refer to Section 4.1 for the routine shutdown procedure. If filtration is done daily, there should be no excessive accumulation of flux in the system and periodic cleaning will be easily accomplished at roughly six-month intervals, depending on production volume and the amounts of flux used.

5.2.2 FILTER CARTRIDGE

The filter should be changed periodically, depending on how long it takes to load up with flux during normal production. This interval can only be determined through experience.

Before removing the filter cartridge, place a shallow pan below the filter cannister. Remove the plug on the bottom of the cannister and drain off the contained fluid. Then loosen the nut at the top of the filter housing. Remove the cannister, leaving the nut assembly on the housing.

Empty any remaining fluid from the cannister and the contents of the catch pan into the tank or a suitable storage container. Remove the cartridge and replace it with a new one from HTC. (Refer to the Parts List in Appendix F.) Allow used cartridge to drain and recapture fluid.

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* If the process material is not liquid at room temperature (such as with Fluorinert FC-71), the system will have to be warm enough for the material to become liquid before the filtration pump can be turned on. Refer to Sections 2.3.1 and 3.1.5 for preheating procedure. Turn off the VAPOR power switch as soon as the material becomes liquid and proceed to bleed the system. (Also see Operation With Alternative Fluids in Appendix H.)

NOTE

The filter housing gaskets should be replaced at every third cartridge change. (Refer to the Piping Parts List in Appendix C.)

CAUTION

Use filter cartridges and gaskets obtained from HTC. Other filter cartridges may contain binder materials which can contaminate the primary fluid when filtering hot. Other gaskets may melt or degrade when primary fluid is hot.

Wipe excess fluid off the sealing surfaces, leaving the gasket slightly damp with fluid, and reassemble the filter unit. Take care to properly seal the joint by turning cannister slightly as the gasket makes contact. Then torque the main nut to 10 ft-lb (13.5 N-m) maximum. Do not overtighten. Be sure to replace the bottom plug on the cannister.

Whenever a new cartridge is installed, run the pump until primary fluid flows freely from the filtration tank return line. Ensure that the fluid level is one inch above the highest heater surface before turning on heater power.* Refer to Section 2.3.1 for procedure to purge air from the filtration piping.

Ensure that the fluid level is one inch (2.54 cm) above the highest heater surface before closing the tank and starting the system.

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* If the process material is not liquid at room temperature (such as with Fluorinert FC-71), the system will have to be warm enough for the material to become liquid before the filtration pump can be turned on. Refer to Sections 2.3.1 and 3.1.5 for preheating procedure. Turn off the VAPOR power switch as soon as the material becomes liquid and proceed to bleed the system. (Also see Operation With Alternative Fluids in Appendix H.)

5.3 ELECTRICAL SYSTEM

Schematics are provided in Appendix B for servicing the electrical system. For regular maintenance, the following should be observed:

5.3.1 TIGHTENING CONNECTIONS

WARNING

Electrical and electronic control devices should be serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment. It is the responsibility of the individual servicing the apparatus to take diligent care.

Ensure that the main disconnect is open before performing any maintenance involving direct contact with electrical connections on this system.

Once a month (as well as at initial installation), check the tightness of all high current electrical connections. This includes all fuse block, heating element, contactor, and grounding bar connections. These connections must be tight, not simply "snug." Use a screwdriver with a blade that fits the screw being tightened to torque each terminal carefully. Special care must be used in tightening the terminal on the contactor; if not done carefully, the housing may be damaged.

CAUTION

Failure to properly tighten contacts will result in poor electrical continuity through the contact. This will result in overheating, or if actually loose, in arcing, burning of the contact and surrounding area, and subsequent failure of the component.

5.3.2 POWER CONTROL

After the monthly connections check, run the system at steady-state so that the operating voltage at each heating element can be checked with a voltmeter. Any unusual voltage drop (more than five percent of rated voltage) should be investigated and corrected. Then, using an Amprobe or similar device, insure that the power control system in reflow or fusion mode of operation is controlling power input from 10 to 100 percent.

If a power controller is faulty, replace it with a proper HTC part. (See the Electrical Parts List in Appendix B.) When installing a new controller, be sure that the mounting surface is flat and clean, and free of any burrs so that the controller contacts maximum surface area. Use enough heat-sink compound to provide complete surface contact. Use lockwashers at both ends of the mounting bolts to ensure that the controller will not loosen with thermal cycling.

5.3.3 SAFETY SHUTDOWN SYSTEMS

A monthly operation check of the heater and water temperature control functions should be made. These tests are done while vapor blankets are established.

WARNING

Dangerous voltages exist on the various printed circuit boards in this system. Contact with components and/or printed circuitry could cause serious injury or fatality. A nonmetallic screwdriver should be used when adjusting the trim pots to avoid any possibility of the screwdriver blade contacting live circuitry and shorting the circuitry or allowing contact with any dangerous or fatal voltages.

The heater element overtemperature sensor trip point and circuit function can be verified by lowering the setting of 1TAS. While lowering the set point an audible "click" should be heard from the relay mounted on the card. This indicates that 1 TAS is functional. Reset 1 TAS to original position. (Refer to 3.3.4 Heating Element Overtemperature Controller for setting procedure.)

Similarly, a monthly operation check of the primary cooling water temperature switch (2 TAS) will verify its proper operation. By momentarily reducing water flow to the primary coil, the primary water temperature will increase, tripping 2 TAS at about 200 F (93 degrees C).

CAUTION

The controller dial (1 TAS) and the primary water flow must be restored to their normal pretest postions immediately after each maintenance check.

5.4 ELEVATOR SYSTEM

The elevator system should be inspected every three months. Tighten all sprocket and pulley setscrews. Lubricate the elevator drive motor output shaft with five or six drops of SAE No. 20 nondetergent oil. Do not over oil.

Twice a year, apply a small amount of bearing grease to the flange block shaft bearings. Again, do not overlubricate. These bearings are sealed and operate at low speed. Too much grease can cause impaction within the bearing which could actually leave the balls and races without direct lubrication.

At each inspection, check the main drive chain for evidence of wear and, if necessary, lubricate it with a good grade of dripless chain oil. If the chain is badly worn, it should be replaced. Refer to the Parts List in Appendix F.

NOTE

The elevator basket support chains extend down into the hot vapors and should not be lubricated. If so desired, these may be replaced with stainless steel chains.

No other normal maintenance is required in the elevator system.

5.5 TANK CLEANING

Under normal operating conditions, the system can operate for many months between cleanings. Proper daily filtration will keep the process fluid relatively clear and minimize accumulation of foreign material in the system. Unless particular operating conditions dictate otherwise, it is well to drain the Fluorinert fluid annually and clean the main tank with a solution of water and baking soda (sodium bicarbonate). If accumulation is excessive, contact the HTC AOS Department.

1. When the system is cool, remove the elevator basket and the tank lid.

PUMP PRIMARY FLUID OUT OF THE TANK

2. To remove all primary fluid from the tank: undo the filter outlet Swagelok fitting and disconnect the tank return line from the filter housing. Fit a short length of 1/2-inch tubing to the filter housing with a length of 1/2-inch I.D. hose clamped securely to the open end of the tube. Pump the primary fluid into a suitable container. (See Figure 5-1 Pumping Fluid Out Of The System.)

3. Loosen the pump inlet fitting and disconnect the upper end of the tube from the tank bottom, taking care to recover any spilled Fluorinert fluid. Swing the tank outlet line aside and carefully tighten the lower fitting to support the idle tube during tank cleaning. Remove the drain hose assembly from the filter housing and attach it to the tank outlet. (See Figure 5-2 Draining The Tank.) Fit a shutoff valve to the open end. (This temporary drain line must be set up while the tank is empty so that it will be ready for use later in draining cleaning solution and rinse water from the tank.)

CLEAN THE TANK

4. Pour up to 3 gallons (11.4 liters) of tap water into the tank. Turn on the ventilation system. To a gallon of luke warm water add one pound of baking soda (sodium bicarbonate) and mix thoroughly. Pour the soda solution into the tank and replace the tank lid.

5. Turn off the water to the cooling coils.

6. Turn on the CONTROL POWER and VAPOR power switches.

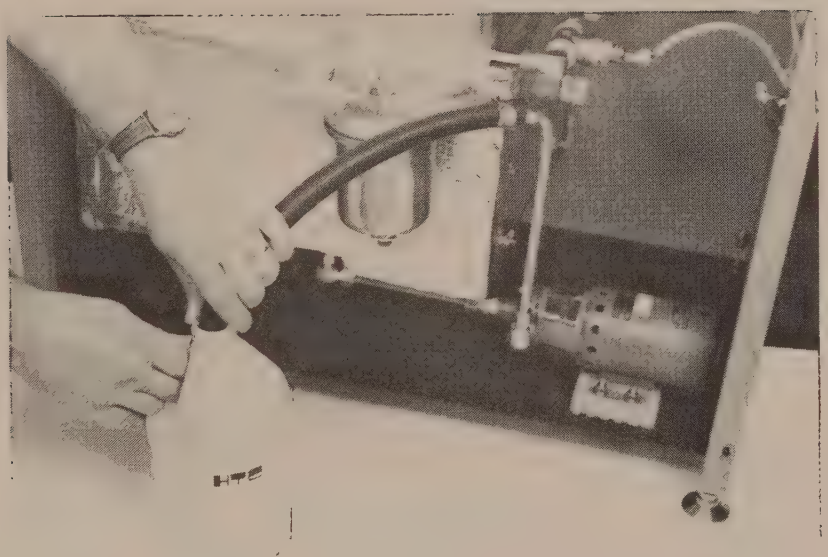

Figure 5-1 Pumping Fluid Out Of The System

7. Turn on the ELEVATOR power switch. Depress the CYCLE START pushbutton to start the elevator. When the chains have lowered about two inches, turn OFF the ELEVATOR switch.

8. Set the VAPOR RATE at 5 or 6 and bring the cleaning solution to a boil in the tank.

9. Boil the solution for two to three hours. Then turn OFF the VAPOR power and CONTROL POWER switches and disconnect all power from the machine. Remove the tank lid and, using a stiff bristle utility brush, scrub down the the tank and the cooling and heating coils.

CAUTION

Do not damage surface of cooling coils.

NOTE

If the tank does not come clean with the boiling soda solution, contact the HTC AOS Department for further instructions.

DRAIN THE TANK

10. When the tank is sufficiently clean, open the drain hose (set up in Step 3, above), and let the solution run into a suitable container for disposal (or, if appropriate, directly into a drain). Rinse the tank thoroughly with fresh tap water and drain dry. Remove all traces of water from the tank and the filtration system. Restore the piping to its normal configuration.

11. Run a fan in the tank overnight to evaporate any remaining water. The following day, rinse the system with R113 secondary fluid to insure that all traces of water are removed from the system. Pump the R113 out of the system into a container containing a bag of desiccant crystals (HTC Part No. 4-00-012) to "dry out" the R113 fluid.

12. Reassemble the filtration piping and install a new filter cartridge. (Refer to 5.2.2 Filter Cartridge.)

13. Turn ON the ELEVATOR power switch and depress the CYCLE START pushbutton. Let the elevator complete its cycle and turn OFF the ELEVATOR switch.

FILL THE SYSTEM

14. Fill the system with clean operating fluids. (Refer to Appendix D Cleaning Of Primary Fluid and 2.3 Fluid Fill.) Check pipe fittings and tank connections carefully for signs of leakage. Tighten fittings that show any signs of leaking.

15. Proceed through normal startup. Refer to 3.0 Operation.

6.0 TROUBLESHOOTING

CONDITION	PROBABLE CAUSE	SOLUTION
6.1 ELEVATOR FAULTS		
Will Not Start: No Movement	Loose electrical connections	Check for and tighten loose connections.
	Blown fuse	Replace fuse 2 FU back of enclosure
	Motor field circuit open	Check resistance of field circuit. If open, resolve fault as required. Verify DC voltage across motor winding.
	Loose sprocket on drive motor	Tighten set screw on drive motor sprocket.
	Defective drive motor	Replace drive motor.
	Speed control card faulty.	Verify input/output voltages: 115 volts AC across pins 4 and 2 100 volts DC across pins 1 and 5 100 volts DC across pins 9 and 5 with elevator speed control at 10 Replace card if faulty.
	Faulty microswitch on step programmer.	Verify operation of switch. Check for DC voltage across wires 21 and 22 on motor.
Fuse keeps blowing:	Worn cam on step programmer programmer.	Verify that 2 SP and 3 SP are actuated simultaneously.

CONDITION	PROBABLE CAUSE	SOLUTION
6.2 COOLING WATER FAULTS		
Low, Cloudy Secondary Vapor Blanket at Startup	Primary cooling water inlet temperature too cold	Increase primary inlet cooling water temperature to 100 to 120 degrees F (38 to 49 deg C).
Secondary Vapor Blanket Rising Above Secondary Coils	Inadequate secondary coil cooling	Increase water flow across secondary coil.
Audible Boiling in Primary Condensing coil	Inadequate flow across primary coil	Increase water flow across primary coil. Verify operation of water temperature switch (2 TAS) at 200 degrees F (93.3 deg C). Measure current or voltage at heater power leads. (Will be zero when switch operates.)
REFLOW POWER Indicator not ON	Defective lamp or loose connection	Replace indicator lamp or repair wiring problem.

CONDITION	PROBABLE CAUSE	SOLUTION
6.3 ELECTRICAL FAULTS (Refer to Electrical Schematic in Appendix B.)		
Quick power checklist (VAPOR and CONTROL POWER ON, VAPOR RATE at maximum)		
Line voltage (230 VAC) to:	1. Main circuit breaker	
	2. Heating element	
	3. Control power transformer	
	4. Proportional controller	
Loss of System Power	Main disconnect open circuit:	Check voltage at main circuit breaker Should be 230 VAC.
	Circuit breaker tripped or defective	Reset circuit breaker 1 CB, or replace if defective.
	Control power fuse blown	Check fuses 1 FU, 3 FU, and 4 FU. Replace if open.
	Defective 230/115 VAC transformer (for control power)	1. Check transformer wiring for loose connections. 2. Check input and output voltage. Should be 230 VAC and 115 VAC, respectively. 3. Replace transformer if necessary.

CONDITION	PROBABLE CAUSE	SOLUTION
6.3 ELECTRICAL FAULTS (Cont'd)		
Heating Element Inoperative	Defective heating element	Check element line current at full VAPOR RATE with Amprobe. Should be 15.65 amps (+10%/-6%). Check element resistance: Turn power off; remove power leads from element and measure element resistance. Should be 14.5 ohms.
	Loose wiring connections	Tighten terminals carefully.
	Defective proportional controller	Check that power control system in both IDLE and REFLOW modes is controlling power input from zero to 100%. Continuous regulation at 100% power indicates a defective controller. Replace controller.
	Defective 230/115 VAC transformer (for control power)	1. Check transformer wiring for loose connections. 2. Check input and output voltage. Should be 230 VAC and 115 VAC, respectively. 3. Replace transformer if necessary.
Erratic Regulation Of Power (Acts like a switch - goes OFF to full ON)	Defective REFLOW or IDLE POWER potentiometer	Turn circuit breaker off. Check potentiometer at settings between 0 and 10. Resistance should increase and decrease smoothly when measured with an ohmmeter. Check parts list for value of potentiometer. Replace if defective.

CONDITION	PROBABLE CAUSE	SOLUTION
6.3 ELECTRICAL FAULTS (Cont'd)		
Erratic Regulation Of Power (Cont'd)	Loose connection in heater circuit	Repair loose connection.
	Defective power control	Replace defective power control (1 PC).
6.4 FILTRATION FAULTS		
Pump Will Not Start	Fuse blown	Check fuse 1 FU. Replace with 5 amp slow acting fuse from spares.
	Defective switch (3 S)	Replace defective switch.
	Motor defective	Replace motor.
Fuse 1 FU Blowing at/after Startup	Filter cartridge clogged	Replace filter cartridge. (Refer to 5.2 Filtration System.)
	Incorrect fuse	Check CONTROL POWER fuse 1 FU (5 amp slow acting). Replace if necessary.
	Fluid too cold	Perform filtration immediately upon sump fluid cooling to 300 degrees F (149 deg C). (Refer to 4.0 Shut-down). Otherwise heater will have to be used to warm up fluid. (Refer to 3.1 Start Up.)
Leakage at Filter Housing	Filter cannister-to-housing joint not properly sealed	Loosen housing nut, reseal, and tighten. Replace gasket if necessary.

CONDITION	PROBABLE CAUSE	SOLUTION
6.4 FILTRATION FAULTS (Cont'd)		
Fluid Dark; Debris in Sump	Fluid not filtered adequately	Run filtration system with fluid temperature between 150 and 300 degrees F (65 and 149 deg C) until fluid is clear. Replace filter cartridge if flow is sluggish.
Fluid Cloudy	Fluid Cold	Normal condition for FC-70 fluid below 65 degrees F (15 deg C).
Fluid Cloudy After Warmup	Contamination in fluid	Run filtration system. Replace filter cartridge if flow is sluggish. Also refer to Appendix D for fluid cleaning procedure.

CONDITION	PROBABLE CAUSE	SOLUTION
6.5 FLUID/VAPOR FAULTS		
Fluid Loss Excessive	Piping and/or through-tank connections leaking	Inspect for fluid loss. Carefully tighten fittings that leak.
	Excessive system ventilation	Recalibrate ventilation to 217 cfm (102 liter/sec) to achieve a face velocity of 100 ft/min (30.5 m/min) across the elevator housing opening.
	Partial collapse of primary blanket due to inadequate VAPOR RATE	Increase VAPOR RATE as required. (Refer to 3.3.2 Reflow Power.)
"Smoke" Around Tank Insulation During Warmup	Tank/heater element interface fittings loose; primary fluid leaking at fittings	Tighten heating element through-tank fittings. (Use wrenches on both sides of fittings.)
	Defective gasket seal at heater terminal	Replace gasket if tightening the through-tank fitting does not solve the problem.
VAPOR Power Off Not ON	Exposure of heating element surface due to insufficient fluid in sump	Add fluid until level is one inch (2.54 cm) above highest heater coil.
Fluid Cloudy	Fluid cold	Normal condition for FC-70 fluid below 65 degrees F (18.3 deg C).

CONDITION	PROBABLE CAUSE	SOLUTION
6.6 PROCESS FAULTS		
Solder Not Fusing	Vapor blanket partially collapsed	Increase VAPOR RATE setting. (Refer to 3.3.2. Reflow Power.)
	Loss of heater power	Locate electrical fault and restore power. (Refer to 6.3 ELECTRICAL FAULTS, above.)
	Incorrect solder alloy	Check process specifications for correct material.
	Idle power too low	Increase idle power setting.
	Vapor power too low	Increase VAPOR RATE setting.
	Excess product mass	Reduce product mass.
	REFLOW timer setting too low	Increase REFLOW timer setting.
Product Exiting Wet	Cavities in product retaining condensate	Reorient product to allow cavities to self-drain.
	Power too low	Increase VAPOR RATE setting.
	Heating element not working properly	Locate electrical fault and restore power. (Refer to 6.3 ELECTRICAL FAULTS, above.)
6.7 TANK FAULTS		
Corrosion On Cooling Coils And Tank Surfaces	Acid build-up in the process fluid	Neutralize acid in tank. (Refer to Appendix J.)

Appendices

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B. ELECTRICAL SCHEMATICS

C. PIPING LAYOUT

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INSTALLATION DRAWING

Appendix B

ELECTRICAL SCHEMATICS

Appendix C

PIPING LAYOUT

Appendix D

CLEANING OF PRIMARY FLUID

Pond Lane
Concord MA 01742
617 369-1110
TWX 710 347-6548

CLEANING OF PRIMARY FLUID

Most Vapor Phase Soldering Systems in production situations include mechanical filtration systems for the removal of flux and other contaminants from the primary fluid sump. This is absolutely essential for the continued safe and efficient operation of the equipment.

For some small development systems and simple beaker/hotplate arrangements, filtration systems are not included but fluid should still be filtered externally.

The primary fluid can become contaminated with acids, due for the most part to breakdown of secondary vapor blanket material, although small amounts are also produced as a result of breakdown of the primary fluid itself. If left unchecked, this acid can lead to corrosion of the cooling coil, tank and product surfaces.

Rather than discarding the expensive primary fluid contaminated by flux, ionic residues, and other particulate matter, a simple manual cleaning process can be utilized.

First, drain the system of primary fluid.

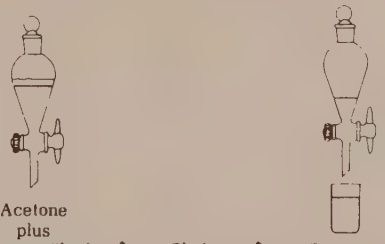
Mix a given volume of the primary fluid in a separatory funnel with approximately one-third the volume of acetone (Step 1). Shake the mixture vigorously for two minutes. The two liquids are immiscible, so when you stop shaking, the heavier primary fluid will separate to the bottom of the funnel where it is easily drained off. Repeat Step 1 with fresh acetone.

Next, mix the primary fluid with water to remove acetone and any accumulated ionic materials and acids (Step 2). Shake vigorously for two minutes. Ionic materials and acids are readily soluble in water and are easily drawn off. Repeat Step 2.

Then, mix the resultant primary fluid with a dessicant (e.g., molecular sieve or calcium chloride) and let stand for two hours to remove any residual water (Step 3). Finally, drain the primary fluid through a coarse filter to remove dessicant.

The primary fluid is now clean and ready for immediate reuse.

Step 1

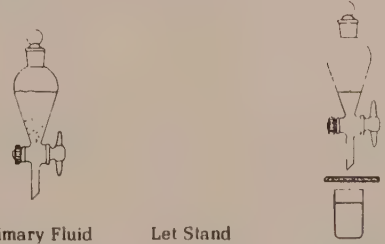


Acetone plus Primary Fluid → Shake → Separate → (Twice)

Step 2

H_2O plus Primary Fluid → Shake → Separate → (Twice)

Step 3



Primary Fluid plus Dessicant → Let Stand for 2 Hours → Drain Through Coarse Filter → Ready for Reuse

Prepared by: Rick Rackin, May 1981

1981 HTC

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Appendix E

MANUFACTURER'S INSTRUCTIONS

Appendix F

SPARE PARTS LIST

Appendix G

CHECKLISTS FOR SYSTEM START UP, SHUTDOWN, and FILTRATION

PRE-START UP

1.	Turn ventilation ON.	3.1.1
2.	Remove tank lid.	
3.	Remove front panel.	
4.	Inspect for leaks.	
5.	Check primary fluid level; replenish as necessary.	3.1.2
6.	Check external secondary fluid supply; refill if less than half full.	3.1.3
7.	Open external secondary fluid supply valve.	3.1.3
8.	Ensure the R113 secondary fluid regulator is open	3.1.3
9.	Turn ON water to primary and secondary coils.	3.1.4

START UP

WARNING

Always wear eye protection, gloves, and long-sleeved clothing to protect against hot surfaces and possible splattering of dragout on product.

1.	Turn all switches OFF.	3.1.5
2.	Set the VAPOR RATE at zero.	
3.	Switch ON the main circuit breaker.	
4.	Switch ON CONTROL POWER - amber indicator lights.	
5.	Switch ON VAPOR power - amber indicator lights.	
6.	The idle power control (1 POT) inside the elevator housing should be set at 8.	
7.	Switch ON ELEVATOR power - amber indicator lights.	
8.	WAIT about 15 minutes for warm-up.	
9.	Adjust the R113 secondary fluid regulator to establish a proper secondary blanket.	
10.	Set the VAPOR RATE at 10.	3.3.2
11.	Ensure that REFLOW and secondary DWELL timers are at normal settings (based on process requirements).	3.3.5 3.3.6
12.	Adjust the ELEVATOR speed to 1-1/2 to 2 fpm.	3.3.8
13.	Load product into the elevator basket.	3.4.1
14.	Depress the START pushbutton to start the production cycle.	

SHUTDOWN

1. Set VAPOR control at zero. 4.1
2. Shut OFF the R113 secondary fluid supply valve.
3. Turn OFF the VAPOR power switch.
4. Remove the elevator basket.
5. Place the lid over the table top opening.
6. Set ELEVATOR speed control at zero.
7. Turn OFF the ELEVATOR power switch.
8. Turn OFF the CONTROL POWER switch.
9. Proceed to Filtration Checklist.

FILTRATION

1. WAIT about one hour until primary fluid temperature is less than 300 degrees F (149 deg C). 4.1
2. Turn ON the FILTER switch.
3. Continue filtration for 30 to 60 minutes.
4. Turn OFF the FILTER switch.
5. Switch OFF main circuit breaker and ventilation.
6. Shut OFF water to primary and secondary coils.

Appendix H

OPERATION WITH ALTERNATIVE FLUIDS

H1.0 SYSTEM OPERATION WITH ALTERNATIVE FLUIDS

In certain instances it may be necessary to operate the HTC Dual Vapor System with a working fluid having a boiling point greater than that of most frequently used FC-70 (419 deg F - 215 deg C). Applications necessitating choice of a higher boiling point fluid include solder reflow of high-liquidus temperature solder alloys and fusion of tinned devices.

A product recently introduced by the 3M Company satisfying these higher operating temperature requirements is called Flourinert FC-71. FC-71 is very similar in chemical composition and thermodynamic properties to its counterpart FC-70, except for its boiling point which is 487 degrees F (253 deg C). Unlike FC-70, however, the solidus temperature of FC-71 is approximately 91 degrees F (33 deg C). At that temperature and below, the fluid exhibits a "slush-like" consistency, making handling somewhat more difficult. 3M recommends heating each FC-71 container to about 100 degrees F (38 deg C) to insure easy pourability and handling.

Provision for insuring liquid FC-71 in the filtration system at start up is achieved by spiral-wrapping an electrical trace heater cable about the interconnecting filtration system lines. Operation of this trace heater during the filtration start up period insures "thawing" of all stagnant FC-71 in the fluid lines, filter, and pump impeller housing prior to pump operation. (See Section H3.0.) The trace heater is factory-installed and wired and requires no operator adjustment.

H2.0 OPERATION

Overall, the Dual Vapor system using FC-71 will operate similarly to its use with FC-70 as the working fluid. Sheet metal surface temperatures will be somewhat greater in the vicinity of the tank, due to the higher boiling point of the fluid. In addition, product exiting the system will be higher in temperature, requiring more care in product handling.

H3.0 AUTOFILTRATION

As in manual filtration, a more extended passive cooling period for the fluid will be required prior to filter pump activation. During this passive cool-down period the trace heating cable is activated, heating the filtration lines, pump impeller housing, and filter assembly. Upon pump start up, the trace heater is disabled. The filtration cycle continues to completion as described for FC-70 operation (Section 4.2).

H4.0 MAINTENANCE

All filtration-related maintenance for the FC-71 fluid usage is identical to that described in 5.0 MAINTENANCE. Should a rapid fluid cool-down be necessary, this can be achieved readily by use of the optional filtration heat exchanger.

Appendix I

SPECIAL OPTIONS

Appendix J

ACID NEUTRALIZER AND DESICCANT MATERIALS

J1.0 Neutralizing Process Fluid

J2.0 DRIERITE Anhydrous Calcium Sulfate

J3.0 SODASORB Soda Lime

J1.0 NEUTRALIZING PROCESS FLUID

Normal operation of dual-vapor soldering systems, boiling Fluorinert fluid generates small amounts of hydrogen fluoride gas (HF). Gaseous HF itself is not a problem, but in combining with water vapor, it forms hydrofluoric acid which does attack metal. Water vapor is present because it diffuses into the system during shutdown periods when air enters the tank. This diffusion rate is humitity-dependent; the higher the relative humidity, the greater the rate of diffusion of water vapor into the tank.

Accumulation of water and hydrofluoric acid is minimized by the presence of two types of color-indicating adsorbent crystals. Equal quantities of anhydrous calcium sulfate (for water vapor) and soda lime (for hydrofluoric acid) are placed in an optional Teflon-coated fiberglass pouch and hung inside the vapor chamber during idle periods after filtration has been completed. (Refer to Appendix F for HTC part numbers for these acid neutralizer/desiccant materials.)

When either the calcium sulfate indicator crystals have turned from blue to rose color or the soda lime crystals have turned from white to purple, they are saturated. BOTH types of crystals must then be replaced.

J2.0 DRIERITE - ANHYDROUS CALCIUM SULFATE
(1 lb container - HTC Part No. 4-00-031)

DRIERITE® *"The Versatile Desiccant"*

THE W. A. HAMMOND DRIERITE COMPANY
XENIA, OHIO 45385

REGULAR DRIERITE

PROPERTIES — Regular DRIERITE is anhydrous calcium sulfate. It is Neutral in reaction, Chemically Stable, Constant in volume, Inert except toward water, Insoluble in Organic liquids, and Refrigerants, Non-disintegrating, Non-wetting, Non-poisonous, Non-corrosive, Repeatedly Regenerative, Non-channeling and Low Cost.

EFFICIENCY — DRIERITE dries gases at 75°F to a terminal dryness of 0.005 milligram of moisture per liter of gas, or 0.31 pound per million cubic feet (National Bureau of Standards Journal of Research, February, 1934), thus is one of the most efficient drying agents known. Ethyl alcohol dried in either liquid or vapor phase is rendered as dry as by refluxing with metallic calcium. Freon refrigerants are dried to a moisture content of less than one part per million. There is very little change in efficiency with rise of temperature to 200°F.

CAPACITY — DRIERITE absorbs instantly 6.6 per cent by weight of water by chemical action, creating the hemihydrate of calcium sulfate. This is the total capacity when drying liquids. When drying gases, DRIERITE absorbs by combined chemical and capillary action, 10 to 14 per cent by weight, the capacity above 6.6 per cent varying inversely with temperature and directly with pressure and partial pressure of water vapor. DRIERITE granules have 38 per cent pore space, which gives the additional capacity in gas drying.

INDICATING DRIERITE

Indicating DRIERITE is Regular DRIERITE impregnated with cobalt chloride and has the property of being blue when dry and changing to rose-red upon absorption of moisture. The color change is pronounced and clearly visible even at a distance. This property makes indicating DRIERITE very valuable in locations where it is desired to know with certainty that dryness is being maintained and to signal the moment when the drying agent should be regenerated or renewed. It has the same efficiency as Regular DRIERITE, and somewhat greater capacity due to the desiccating effect of the cobalt chloride.

Forms of DRIERITE — The granular forms of DRIERITE are available in sizes ranging from powder to ¼" mesh, weighing approximately 60 pounds per cubic foot. The powder is very well-suited for removing last traces of moisture from organic liquids. The most popular sizes for other applications are the 20-40 mesh, 10-20 mesh, 8-mesh, 6-mesh, and 4-mesh granules. The granules and powder are available in one and five pound lots in glass bottles or in twenty-five pound lots in metal cans. Special containers are readily made available for special applications.

PACKAGING Regular DRIERITE and Indicating DRIERITE	SHIPPING WEIGHTS
1 lb. Carton Lots of 12 x 1-lb.	23 lbs.
5 lb. Carton Lots of 4 x 5-lb.	33 lbs.
25 lb. (Metal Can) 1 x 25-lbs.	28 lbs.

REGENERATION

The exhausted DRIERITE should be spread about ½-inch deep in shallow metal pans or trays and heated in the oven to effect complete dehydration. Heating in this way at 200 to 225°C for 1 to 2 hours is sufficient even for the large granules. The regenerated material should be placed in the original container and sealed while hot. The date of the regeneration should be recorded on a label attached to the container.

For the regeneration of Indicating DRIERITE, as well as for small lots of Regular DRIERITE, the granules may be spread in layers one granule deep and heated for the same time and temperature as suggested above. The colors of the Indicating variety may become less distinct on successive regenerations due to the movement of the pigment into the body of the granule.

J3.0 SODASORB - SODA LIME

HTC recommends the use of soda lime to neutralize the hydrogen fluoride gas produced by the boiling of Fluorinert in the Vapor Phase soldering system.

Sodasorb® brand of soda lime is a mixture of calcium hydroxide and sodium or potassium hydroxide or both. The granules are white or grayish in color. The color indicator added to the soda lime is colorless (i.e., white) in fresh Sodasorb, which is strongly alkaline. As the indicator granules absorb the HF gas, they become less alkaline and turn violet or purple with increasing intensity. The color change is vivid, and is easily observed, even under difficult visual conditions.

Sodasorb is avilable in 3-pound containers from HTC (Part No. 4-00-030) or from the Puritan-Bennett Corporation, General Offices, Oak at Thirteenth Streets, Kansas City, MO 64106.

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MP MASTER
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